

Calibration report of the profiling reflectance radiometer Plumes & Blooms - UCSB

Instrument Details

Name: Biospherical Instruments
Model: PRR-600
Serial Number: 9628
Purchase date: 22-December-1994

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I) Introduction

The PRR-600 is a hand-lowered profiling reflectance radiometer designed to measure downwelling irradiance, upwelling irradiance, and reflectance in the SeaWiFS wavelength bands. The instrument measures seven channels each of downwelling irradiance and upwelling radiance (412, 443, 490, 510, 555, 665 nm, and PAR (400-700 nm)). Temperature and depth/pressure transducers operate to 200 m. Tilt and roll sensors are also included.

The PRR incorporates a free-fall design that allows it to drop away from the ship and avoid ship-shadow. Filter photodetectors in the head of the unit are specified to 10 nm FWHM +/- 1 nm with center wavelengths designed to hit the SeaWiFS bands while taking into account details such as the viewing geometry of the system. Both the irradiance and radiance detector geometries have been designed to limit the solid angle to 10 degrees, and the filter design has been specified to compensate for this solid angle in arriving at the center wavelengths and bandwidths in the assembled instrument. The PRR-600 irradiance collector is Teflon®, backed with quartz, optimized for excellent cosine response in water.



II) Calibration and Maintenance

A. Our Facility

The PRR-600 is calibrated twice each year on an optical table in our own climate-controlled lab. Our calibration lamps are attached to a rail mounted to the table and can easily slide back and forth in order to provide calibration distances from 50 cm to over 2 m.

B. Calibration Lamp History

Five lamps were used for calibrations of the PRR-600 since 1995 — F-303 F-304, F-305, F-472 and F-476— all of which are traceable to the National Institute of Standards and Technology (NIST). Lamp F303 was purchased in June 1992 and was used for all routine calibrations at UCSB from July 1992–July 1995 (Plumes & Blooms began March 1995). It was then recalibrated by Optronics in July 1995 after approximately 50 h of service.

Lamp F-304 was a seasoned, uncalibrated FEL lamp, purchased in June 1992, and used only a few hours until July 1995 when it was calibrated by Optronics and put into use for routine calibrations at UCSB. A fourth lamp, F-305, was not calibrated by the manufacturer, but has been used for comparisons between other lamps. Lamps F-474 and F-476 are currently being used for calibration.

C. Procedure

The wavelength properties of each detector on the radiometer are measured using a double-grating monochrometer. An uncalibrated FEL lamp and condensing lens are used as the illumination source for the entrance slit, and the output spot is centered on the radiometer's cosine collector or on an individual radiance detector. The wavelength producing the maximum signal is then determined, followed by the wavelengths on each side of the peak producing 50% of the maximum signal. The reported wavelength for a detector is the average of the two half-maximum wavelengths; its bandwidth is the difference between these two wavelengths. The wavelength response of the monochrometer is calibrated by observing the visible spectral lines of a mercury pen lamp. Repeat determinations for any detector have generally agreed to within 0.5 nm.

A certificate is created after each calibration event and includes information about the following references:

- Dark readings
- In-house calibration factors
- Manufacturer's original calibration coefficients
- Percent change for each sensor

We post the most recent version at the following link:

- http://www.icess.ucsb.edu/PnB/PRR_Calibration/PRR9628.PDF

DOWNWELLING IRRADIANCE (9628_0):

Channel	Darks	Calibration Factor (WET)	Calibration Factor (DRY)	Original Calibration (DRY)	Change in DRY factor since 1995
412	-0.000077	-0.023321	-0.018999	-0.027248	30.27%
443	-0.000004	-0.016360	-0.023524	-0.025817	8.88%
490	0.000198	-0.023916	-0.033982	-0.035875	5.28%
510	-0.000376	-0.016774	-0.023725	-0.03399	30.20%
555	-0.000290	-0.020339	-0.028473	-0.033411	14.78%
665	-0.000247	-0.017035	-0.023321	-0.032774	28.84%

UPWELLED RADIANCE (9628_1):

Channel	Darks	Calibration Factor (WET)	Calibration Factor (DRY)	Original Calibration (DRY)	Change in DRY factor since 1995
412	-0.000077	-0.023321	-0.018999	-0.027248	30.27%
443	-0.000004	-0.016360	-0.023524	-0.025817	8.88%
490	0.000198	-0.023916	-0.033982	-0.035875	5.28%
510	-0.000376	-0.016774	-0.023725	-0.03399	30.20%
555	-0.000290	-0.020339	-0.028473	-0.033411	14.78%
665	-0.000247	-0.017035	-0.023321	-0.032774	28.84%

III. Deployment / Sample collection

The PRR-600 is deployed at the aft of the ship – in order to avoid ship shadow and is typically lowered (by hand) to a maximum depth of 150m.

IV. Data processing

The Plumes & Blooms radiometric data are processed using the BBOP Data Processing System – a combination of C++ and UNIX commands that provide a quality controlled and quality assessed 1m binned data set. The system was originally developed through a collaboration with JGOFS in 1995 but is currently being updated to allow for use on a broader range of platforms – such as MATLAB.

At the heart of the BBOP processing system is the structure of the 'lcd' file (least common denominator). The lcd file is an independent, self-contained data file with all pertinent header, calibration information and processing history included. A series of filters are then applied to the lcd, which either replace (flag) data or add new data. Below is a list of the BBOP filters with a short explanation of each:

- bbopstrip: extract lcd data columns and writes them to a simple ASCII file
- bbopfutil: deletes or retains fields from the lcd file and writes the results as a new lcd file
- bbopdeflag: removes or keeps lines based on flag values
- bboprecal: recalculates sampled parameters using new scales and offsets
- bbopmath: performs simple calculations
- bboptrans: performs transformation operations (log, sqrt, sin, etc)
- bbopangq: compares package angle data to a constant and writes a quality flag
- bbopradq: compares data to thresholds and replaces values below thresholds with quality flags
- bbopkq: calculates changes in incident irradiance over a depth interval and writes a quality flag
- bbopdespike: replaces spiked data with a mean of windowed points using forward-first difference and/or slope difference
- bbopmovag: smooths data using a moving window
- bboph20: calculates seawater properties using Unesco algorithms
- bbopbin: breaks the cast into profiles, sorts the profiles and averages data over depth intervals creating new lcd files for each profile
- bscal: extrapolates data to the sea surface (z=0-) over a specified depth window (approximately 10 – 12 meters for Plumes & Blooms)
- bbopkc: calculates diffuse attenuation coefficients from radiometric data

We post the full manual for the BBOP Data Processing & Sampling Procedures at the following link:

http://www.icess.ucsb.edu/bbop/Data.html/BBOP_processing_manual.PDF

V. Additional Information

A. Factory Specifications:

- Optical Features: Measures 7 wavelengths of downwelling irradiance (380, 412, 443, 490, 510, 555 nm, and PAR (400-700 nm)) and upwelling radiance (380, 412, 443, 490, 510, 555, and 683 nm (natural fluorescence)) .
- Housing: Delrin®, measures 10 cm in diameter by 40 cm in length.
- Weight: 5.4 kg (in air).
- Other Sensors: Pressure/depth sensor and platinum resistance temperature transducer.
- Maximum Operating Depth: 50 or 200 m - depending on pressure transducer.
- Bradley systems available by request.
- Housing: NEMA Type-4 certified enclosure.
- Operating System: Microsoft Windows NT®.
- Communication Software: Microsoft's Remote
- Access Service (RAS) software.
- Power Requirements: 120 VAC, 60/50 Hz.
- RAC to Mooring: Multi-conductor, multi-jacketed Kevlar®-reinforced hydrowire for communication and power supply (maximum length 1 km).